Claims

1. A powderous transition metal compound comprising at least 85 %w/w of transition metal and oxygen,

wherein the powder consists of particles which have a significant spatial change of transition metal stoichiometry, where the average transition metal compositions in the outer bulk differ by at least 10% from the average transition metal compositions of the inner bulk,

the inner bulk being specified as a region around the center of the particle containing about 50% of the total number of transition metal atoms of the particle.

2. The powderous transition metal compound according to claim 1, having average transition metal composition $M=(Mn_{1-u}Ni_u)_{1-y-z}Co_y$ where $0.2<u<0.7$ and $0.1 < y < 0.9$,

wherein the average transition metal compositions of cobalt as well as manganese as well as nickel in the outer bulk differ by at least 10% from the average transition metal compositions of the inner bulk,

the inner bulk being specified as a region around the center of the particle containing about 50% of the total number of cobalt, nickel and manganese atoms of the particle.

3. The powderous transition metal compound according to claim 2, having average transition metal composition $M=(Mn_{1-u}Ni_u)_{1-y-z}Co_y$ where $0.4<u<0.65$ and $0.2 < y < 0.9$,

wherein the average transition metal compositions of cobalt as well as manganese as well as nickel in the outer bulk differ by at least 15% from the average transition metal compositions of the inner bulk.

4. The powderous transition metal compound according to 2, having average transition metal composition $M=(Mn_{1-u}Ni_u)_{1-y-z}Co_y$ where $0.4<u<0.65$ and $0.2 < y < 0.9$,

wherein the powder consists of particles which have the same crystal structure everywhere in the bulk of the particle.

5. The powderous transition metal compound accoding to 2, having average transition metal composition $M=(Mn_{1-u}Ni_u)_{1-y-z}Co_y$ where $0.4<u<0.65$ and $0.2 < y < 0.9$,

wherein an inner bulk is a lithium transition metal oxide with layered crystal structure with space group r-3m

6. A powderous lithium metal oxide, wherein at least 90% of the metal is transition metal with average composition $M=(Mn_{1-u}Ni_u)_{1-y-z}Co_y$ where $0.4<u<0.65$ and $0.2 < y < 0.9$,

the powder consisting of particles which have

- the same layered crystal structure with space group r-3m everywhere in the bulk of typical particles

- a significant spatial change of transition metal stoichiometry, where the average transition metal compositions of cobalt as well as manganese as well as nickel in the outer bulk differ by at least 10% from the average transition metal compositions of the inner bulk,

the inner bulk being specified as a region around the center of the particle containing about 50% of the total number of cobalt, nickel and manganese atoms of the particle.

7. The powderous lithium metal oxide according to 6, wherein at least 95% of the metal is transition metal with average composition $M=(Mn_{1-u}Ni_u)_{1-y-z}Co_y$ where $0.4<u<0.65$ and $0.25 < y < 0.45$ or $0.65 < y < 0.85$,

the powder consisting of particles which have continuous spatial change of transition metal stoichiometry.

8. The powderous lithium metal oxide according to 7, having average composition

$M=(Mn_{1-u}Ni_u)_{1-y-z}Co_y$ where $0.4<u<0.65$ and $0.65 < y < 0.85$,

wherein the inner bulk has an average composition $M=(Mn_{1-u}Ni_u)_{1-y-z}Co_y$ where $0 \leq u \leq 1$ and $0.75 \leq y \leq 1$.

9. A method for preparing powderous transition metal compounds according any one of the claims 1-8, comprising at least one precipitation reaction,

wherein at least one solution of dissolved transition metal salt and at least one solution of dissolved hydroxide of carbonate salts are added to particles acting as seeds; dissolved transition metal cations and dissolved hydroxide or carbonate anions form a solid precipitate; and the precipitate forms a layer covering the seed particles,

the precipitate having a transition metal composition M2, which differs from the composition M1 of the seed particles by at least 10%.

10. The method according to 9, wherein the precipitate has a transition metal composition $M2=Mn_{1-a-b}Ni_aCo_b$, which differs significantly from the composition $M1=Mn_{1-a'-b'}Ni_{a'}Co_{b'}$ of the seed particles, significantly being defined that the absolute value $|N_i|>0.1$ for all numbers $N_a=(a'-a)/a'$, $N_b= (b'-b)/b'$ and $N_c= (c'-c)/c'$.

11. The method according claim 10, wherein the seed particles are a lithium metal oxide where at least 95% of the metal is transition metal with average composition $M=(Mn_{1-u}Ni_u)_{1-y-z}Co_y$ where $0.4<u<0.65$ and $0 \leq y \leq 1.0$ having a layered crystal structure with space group r-3m

12. A method according claim 11, where the seed particles are a lithium metal oxide where at least 95% of the metal is transition metal with average composition $M=(Mn_{1-u}Ni_u)_{1-y-z}Co_y$ where $0.4<u<0.65$ and $0.75 \leq y \leq 1.0$ having a layered crystal structure with space group r-3m.

13. The method according any one of the claims 9-12, wherein the precipitate contains further anions chosen from SO_4^{2-}, Cl^-, F^- and/or further cations chosen from Na^+, K^+, Li^+ and the total concentration of these anions and cations exceed 0.01 mol per 1 mol transition metal of the precipitate.

14. The method according claim 13, wherein the content of further anions and/or cations in the precipitate is modified by an ion exchange reaction, following after the precipitation reaction.

15. A method for preparing powderous lithium transition metal compounds according any one of the claims 1-8, comprising steps of

at least one precipitation reaction according any one of the claims 9 to 14;

a heat treatment between 110-350°C to modify the precipitate ; and

a solid state reaction of the modified precipitate with a source of lithium

16. The method according claim 15 to prepare powderous lithium transition metal compounds, described in any one of the claims 6-8, the lithium transition metal compound basically being free of further anions and cations including Cl^- , SO_4^{2-} , Na^+ and/or K^+, by removing these anions and/or cations either by an ion exchange reaction after the precipitation reaction, or by a washing after the solid state reaction.

17. A rechargeable lithium battery containing powderous lithium transition metal oxide according any one of the claims 6-8.